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Procedia Earth and Planetary Science 1 (2009) 1695–1704

Procedia Earth and Planetary Science

www.elsevier.com/locate/procedia

The 6th International Conference on Mining Science & Technology

Energy service companies to improve energy efficiency in China: barriers and removal measures

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Abstract

Since China became the second largest energy consumer and carbon dioxide emitter, Chinese government has put high emphasis on the problem of energy consumption and environmental pollution, and has put the project of energy conservation and emission reducing into practice. Energy service companies (ESCOs), a market oriented mechanism by energy performance contracting (EPC) to improve energy efficiency, had successful experiences in developed countries such as USA and Canada, and developing countries such as South Korea. ESCOs are in nascent stage in China and face several barriers that include market, finance, institutional, technology, risk control, educational and dissemination barriers, and poor energy pricing policies, high transaction costs problems etc. Thus, a series of corresponding countermeasures should be taken effectively to remove these barriers for promoting ESCOs to improve energy efficiency by energy performance contracting (EPC) in China in favor of Chinese economy kept going sustainably.

Keywords: ESCOs; energy efficiency; barriers; removal measures

1. Introduction

Nowadays, China is experiencing rapid development of economy and society, and with higher level of modernization and standard of living, China will consume more and more energy. Due to low efficiency in generating and using energy, Chinese economic development was based on high-resource consuming pattern, and cannot continue growing very fast and consume resources at the same efficiency it has thus far. Until now, China has become the second largest energy consumer and greenhouse gas emitter [1], and thus, energy consumption and environmental pollution have become serious and great problems in China, which draws the global attention. Its share of new carbon dioxide emissions is expected to rise to 40 percent of the world's total by 2030 if measures are not taken to reduce them [2]. Meanwhile, as a member of the United Nations Framework Convention on Climate Change, China has the obligation to reduce emission of greenhouse gases to protect globe environment and to promote sustainable development of the world. In order to deal with the conflicts between Chinese economic sustainability and environmental pollution, more and more energy consumption and an enormous pressure of

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doi:10.1016/j.proeps.2009.09.260

greenhouse gases mitigation, energy resource limitation and energy security, the project of energy conservation and emission reducing initiated by Chinese government has been put into practice. A series of laws and decrees have been taken into effects to increase energy efficiency, strengthen energy conservation, develop renewable energy and optimize energy structure as well. In June 2004, the Chinese government released its Special Plan on Energy Conservation in the Mid- to Long-term, with its focus on reducing China's GDP energy intensity by 20%, as well as a reduction in the total emissions of pollutants by 20% below the current level.

Officially in 1998, a key international cooperation project in the field of energy conservation by Chinese government and World Bank/GEF (Global Environment Facility) was introduced to China. The main purpose of this project is to promote market-oriented Energy Performance Contracting (EPC) mechanism and develop Energy Service Company (ESCO) industry in china. Since then, supported and pushed energetically by Chinese government, ESCO industry development in China has a great success, and the market-oriented EPC mechanism has played an important role in energy conservation to promote sustainable development of Chinese economy.

2. The current situation of ESCOs in China

ESCOs, which had successful experiences in developed countries such as USA and Canada, and developing countries such as South Korea, are generally viewed as companies that are engaged in developing, installing and financing comprehensive, performance-based projects, typically 5~10 years in duration, centered on improving the energy efficiency or load duration of facilities owned or operated by customers.

However, most ESCOs typically have the following capabilities and skills: project development, engineering and design, feasibility analysis, energy analysis, general contracting, ability to finance directly or arrange third-party financing, project and construction management, purchase and installation of equipment, risk management, monitoring and verification of savings, training, operations and maintenance services for the installed equipment, and administrative services.

The concept of ESCO entered China at a time when energy had become a global issue, whereas China's energy constraint was rapidly growing at a remarkable rate, partly due to low efficiency in generating and using energy. The ESCO concept was brought into practice in 1998 when the first phase of the World Bank/Global Environment Facility Project (WB/GEF project) on Promoting Energy Conservation in China was initiated. The project aimed at introducing the concept of ESCO into China through establishing three pilot ESCOs, whose primary business was to gain revenues through Energy Performance Contracting. The second phase of the WB/GEF project is currently being implemented through enhancing the capacity of China's ESCOs by providing strong loan guarantees to ESCOs as well as the establishment of the Chinese EMC Association (EMCA), which was founded in April 2004.

During the past years, there has been a tremendous expansion of China's ESCO industry, both in terms of the number of new ESCOs entering the market and the size of investments in ESCO projects. These are shown in Fig. 1 and Fig. 2.

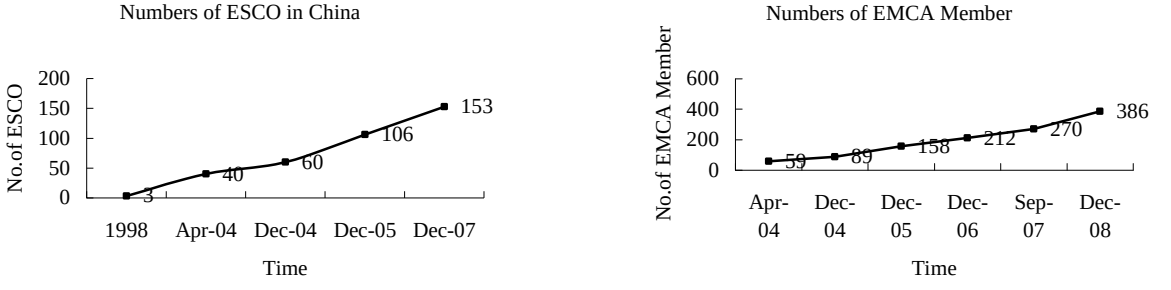

Fig. 1. (a) Numbers of ESCOs in China ; (b) Numbers of EMCA member in China (Sources: from EMCA.)

A more recent trend suggests that foreign ESCOs, especially those from the USA and Europe, such as Mainland Hope, Broad air-condition, and Fortune United, etc., are starting to open subsidiaries China. One of the key features of the foreign ESCOs is that they often come with energy efficient technologies and are willing to operate the project as a coowner in order to maximize their interests.

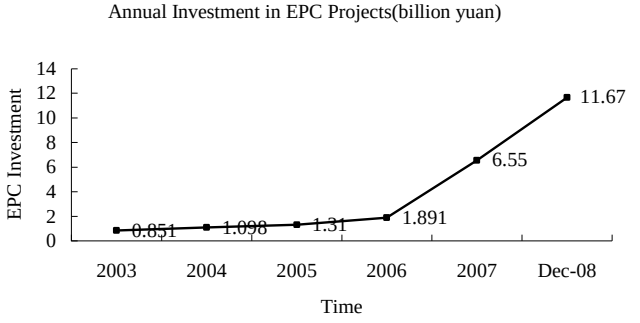

Fig. 2. Annual investment in EPC projects in China (Sources: from EMCA.)

The past few years has seen a rapid expansion of the ESCO business penetrating into China's economy and playing an important role in achieving China's goal in energy conservation. The performance of the ESCO business for energy conservation in China is shown as the achieved reductions of tons of standard-grade coal, and emissions equivalent to tons of carbon during the past few years. (Fig. 3)

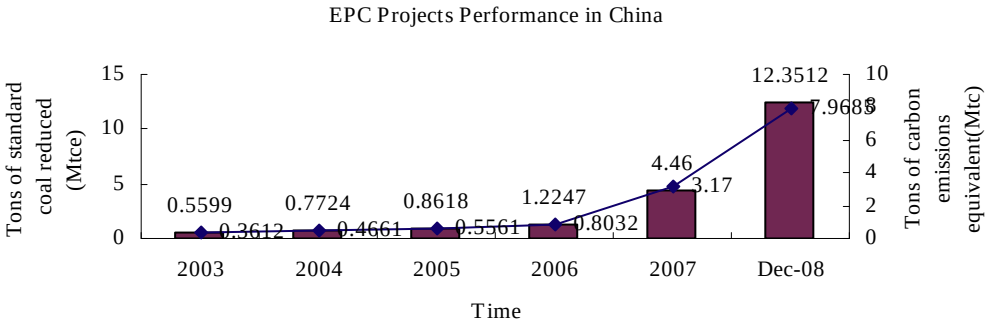

Fig. 3. EPC projects performance in China (Sources: from EMCA.)

Such results show the ESCO industry's energy conservation efforts have the potential to significantly reduce the climb in China's coal use-a major source of greenhouse gases, which contributes to improvement of global environment.

One distinctive feature of China's ESCOs is that, among others, the shared savings and guaranteed savings contracts have proved popular in China. The types of EPC in China and its' attributes are shown in Table 1.

At present, the current ESCO projects implemented in China are as follows: green light, heating network, boiler retrofit projects, central air conditioning, integrated power saving, heat pump projects, industry projects, variable frequency/variable-speed drive projects, combustion of (waste) gas for electricity generation, waste heat recovery, heat (and cold) storage projects, and energy substitutes, etc. The majority of ESCO projects are central air conditioning, industry projects, and heat (and cold) storage projects.

Based on analyzing the historic and current situation of ESCO industry in China, the rapid development of the Chinese ESCO industry can be attributed to the following factors: Chinese large market potential in energy efficiency, International and governmental support-the WB/GEF project, good practice in managing credit risk,

rising awareness of cost saving potentials through energy conservation in industries, transfer of advanced know-how, and combination with the Clean Development Mechanism (CDM).

Table 1. Types of EPC in China and its' attributes

Type of EPC	Development trend	Market distribution	Number of projects (implemented in 2005)	Duration of the contract
shared savings contract	Keep as main stream	Buildings	19%	Average 4.5y, Max 10y.
guaranteed savings contract	Increasing	Industries	76%	
Outsourcing energy management contract	More to come	Commercial buildings, such as hospital, hotel and supermarkets, etc.	5%	Average 10y, Max 15y.

Sources: from EMCA

3. Barriers to ESCOs growth in China

Although the ESCO industry in China has a rapid expansion in recent years, and benefits from EPC agreements are considerable, compared with huge potential market and the energy conservation and emission reduction goal established by Chinese government, it is quite insufficient and the size is small for ESCO industry in China. The ESCO industry should be fostered and supported to be developed progressively, and contribute to Chinese energy efficiency more enormously. However, a lot of barriers hinder many cost-effective energy efficiency projects and prevent the full development of the ESCO industry in China. These barriers can be classified as follows.

3.1. Market barriers

Creation of a market for ESCOs has been hampered for following reasons:

1) Low awareness and lack of information about the ESCO concept

In China, ESCO industry is in nascent stage, and Energy Performance Contracting (EPC) is not familiar to large number of potential clients, financial institutions, guarantee institutions, tax department, which results in the potential clients are not aware of this solution to energy efficiency, makes it difficult for ESCOs to secure financing.

Many companies may not be aware of the energy efficiency potential due to information gap, managerial indifference, incompetent management, lack of interest and so on.

Again, potential clients are little interested in EPC because their attention is on their core business (private clients) or main mission (public bodies) and energy constitutes a small part of their expenses.

A lack of aggressive marketing of energy efficiency projects has also been cited as a barrier by some industry experts.

2) A lack of government support and involvement as a customer

A large potential for energy efficient projects lies in government owned facilities. Under current financial management of Chinese government organizations, ESCO has difficulties to implement energy efficient projects for Chinese government organizations because ESCO can't share the benefits of energy efficiency[3].

3) Credit risk and improper societal creditworthiness environment in China

China is still a country in economic transition and a strong credit system has not been established. This is a standing obstacle that has not been changed significantly in China, which results in some of the ESCO clients are afraid that the energy efficiency commitment would not function as expected, and in return the ESCOs suspect whether the clients would share the benefits of energy efficiency with them in terms of the EPC agreements or not.

Many ESCO clients have been observed not to accept the energy savings and to break the contracts in the end and some ESCOs have to give up their interests due to that in China [4].

4) Lack of confidence of ESCO services and solutions because of poor capabilities

The majority of ESCOs in China are small and medium scale enterprises, few of large companies and groups, and they can't provide comprehensive and quality services due to their poor energy efficiency technologies and

competency. The potential clients of these ESCOs are lack of confidence of their services and solutions because of poor capabilities. The small and medium scale ESCOs with few projects and references are often viewed with skepticism. Under these circumstances, it is difficult to promote ESCOs on a large scale and quickly in China [5].

3.2. Institutional barriers

1) Institutional barrier in evaluating enterprise leaders and lack of economic incentives for energy efficiency

A considerable energy savings potential lies in the large-scale state-owned enterprises. The leaders of these enterprises often serve for an average term of 3-5 years. For a lot of these business leaders, an ESCO business means using the current resources to save money for their successors. However, the assessment method to evaluate these leaders primarily takes into account the current performance of the top management in generating revenues, business expansion, making profits, and the operation performance are tied with their individual incomes, so that the large potential to save cost from energy saving has been more likely to be less prioritized, little of their attention are paid to the energy efficiency, and the ESCOs have few opportunities to cooperate with them for energy efficiency [6-7].

2) The taxes and fees are high for ESCOs, existing tax and fiscal system discourage energy efficiency

In developed countries where EPC experienced successfully, favorable tax policies were constituted by the government to promote ESCOs, which attracted more and more enterprises to participate the array of ESCOs, and urged the industrialization of ESCOs [8-9].

At present, Chinese government has no specific supportive policies to extend EPC, and the department of tax has no favorable policies for ESCOs to implement the energy efficiency services, which results in badly influencing on the capabilities of self-development and business expansion, restraining the industrialization procedure of ESCOs.

It is very difficult at the nascent stage for potential EPC agreements to finance from the capital markets because low awareness and lack of information about the EPC business. In western developed countries, the large part sources of EPC funds are from special discount interest loans provided by the governments, and special funds for electric demand-side management. However, in China, neither commercial loans of banks nor fiscal subsidies of government facilitate the development of EPC and ESCOs [10].

3) Lack of guarantee of laws, no existing legal framework for protecting the interests of EPC participants

There are no laws to provide effective promotion and regulation for the implementation of EPC. The Chinese laws and decrees about energy conservation emphasize the supervising and administrative functions of each ministry and commission, and all levels of government, but lack of specific statements about standardization and expansion of energy conservation markets, and lack of maneuverability of relative items.

For example, there are no specific regulations of the bid procedures and the standards of measurement and verification for EPC, and lack of related laws and codes for solving the problems of EPC refund risk [11].

4) Administrative hurdles and high transaction costs

Limit willingness to participate, mainly in the public and residential sector. These not only limit the clients' interest, but also keep ESCOs away.

3.3. Financial barriers

It is crucial for overseas ESCOs to survive in the competitive markets that the ESCOs can provide abundant funds, equipments and technologies to help enterprises implement energy efficiency projects, whereas these enterprises requiring for energy efficiency lack of enough funds [12-15]. However, the majority of ESCOs in China are small and medium scale enterprises (SMEs), and it is difficult for them to survive because of financing barriers.

1) The duration of implementation of energy efficiency project is long, and the revenue capacity of the project is poor in the near term

It is required that the ESCOs have large amount of funds as the working capital funds because the average period of implementation of energy efficiency project is above 3 years, which results in the revenue capacity of the project is poor in the near term. For most of the ESCOs in China, except supported with special funds from World Bank, they have to use their own equities to conduct proposed projects. Furthermore, even if the ESCOs can acquire supports with special funds from World Bank, but for the Chinese huge potential energy conversation market and the requirements of self-development of ESCOs, the funds provided by World Bank is utterly inadequate in dealing with the severe situation. The ESCOs in China will face a risk whether they can continue to survive or not, and it is

difficult for the EPC mechanism to be pushed smoothly, if the steady sources of funds are not settled fundamentally and channels of fund sources are not expanded.

2) Lack of credit appraisal mechanism and the rating granted by the bank is low

Most Chinese ESCOs are small in size and do not have sufficient funds to support large investments on their own. The serious lack of awareness in the banking system makes it more difficult for small size ESCOs to secure financing energy efficiency projects based on EPC through third party financing, as banks are conservative and require solid collateral as loan guarantees for any loan they grant. Small ESCOs cannot source enough equity as guarantee to get loans from banks because banks suspect their credit rating which is viewed very low. One of the problems with financing is that banks often assess the creditworthiness of the client instead of the project itself, with which a lot of good projects are excluded from financing. Furthermore, there is high uncertainty for banks as to whether the customers will be able to pay back the loan with predicted performance, which adds to the difficulties that ESCOs face.

Many new ESCOs in China could not demonstrate transparent financial and accounting systems required to convincing investors.

Furthermore, it is conservative for banks and financial institutions to loan to Chinese ESCOs because a shortage of bank finance available and the lack of loan category suitable for EPC projects, and banks lack of appraisal ability to evaluate risks of EPC projects.

3.4. Technology barriers

1) Absence of standardized procedures for energy audit and energy conservation measurement and verification, it is difficult to evaluate the effects of the energy efficiency projects

In China, the ESCOs industry is in the initial stage, there has no well-rounded industry criteria, such as service standards, energy conservation measurement and verification methods, and contract standards, etc [16].

There is a lack of a standardized procedure that is enforceable to conduct an energy audit before implementing an ESCO project. Internationally acknowledged protocols are not widely promoted because these are not legally enforceable national standards which may still raise issues during implementation. The customer often holds disputes with ESCOs with regard to the procedures to conduct an energy audit ex-/post- ante, as well as the savings achieved through implementing the proposed solutions.

2) A lack of skill and technical competence for energy efficiency in the ESCOs

Many Chinese ESCOs were weak in specialization in the very beginning when they came into existence. Because some ESCOs utilize unpracticed energy efficiency technologies or lack of understanding energy efficiency technologies, the enterprises throw doubts upon whether the proposed projects can get the effects as expected and influence the enterprises' normal operation or not.

In fact, the dada of energy efficiency performance provided by some ESCOs is largely calculated theoretically, and the effect of energy efficiency may not be obvious when the proposed project is put into practice and operated under the practical conditions. If the enterprises can not get the effects as expected after they implemented the proposed projects recommended by the ESCOs, a lot of negative effects on the development of EPC mechanism may be taken place in the whole ESCOs industry or socially. This is a common problem presently in the course of extending the EPC mechanism in China, and this problem should be settled as soon as possible.

3) Lack of qualified professionals to carry out energy efficiency projects, shortage of energy-efficiency technology

At present, many of the Chinese industries are willing to conserve energy urgently but their motivation was depreciated by lack of technology and know-how due to the high cost of technology imports and lack of qualified personnel to implement their energy saving plans.

4. Barriers removal measures for promoting ESCOs in China

Based on a review of the literatures and study the actual situations in the field, barriers removal strategic measures should be taken for fostering the development of the ESCO industry in China [17-21].

1) The first measure is to increase dissemination of knowledge and national policies about energy efficiency, and build up awareness of energy conversation and promote EPC

The dissemination of the Kyoto Protocol and its flexible mechanisms (emissions trading, clean development mechanism, and joint implementation), and the related proposals for directives on energy demand management for responding to these mechanisms will create a new opportunity for developing the ESCO industry in China. Energy-efficiency projects offer very cost-effective approach for reducing greenhouse gas emissions. Emerging carbon markets will create new opportunities for project financing and the further diffusion of monitoring and verification techniques used in energy performance contracting.

Propagandizing and education for energy conversation through diversiform approaches, and rising awareness of EPC and services offered by ESCOs among all levels government officials, enterprises energy managers, banks and financial institutions, boosting their enthusiasm for participation in energy saving. Furthermore, we should mobilize the social measures of supervising energy conservation, and make it a self-conscious action for all people to save energy, encourage people to pay attention to economic costs for energy consumption.

It is suggested that to encourage large specialized energy conversation companies, such as Chinese Energy Conservation Investment Corporation, participate in the task of expanding the EPC. Central state-owned enterprises should consider the task of expanding the EPC as important work, promptly concentrate manpower, material resources, and funds on the work system of expanding the EPC, and act as the main force to expand the EPC.

2) The second measure is to rationalize energy prices and remove or reduce subsidies, and protect environment through energy efficiency projects

Energy prices will go up significantly in almost all countries as a result of increasing world energy prices in the long run, stricter environmental regulation, and/or the removal or rationalization of subsidies, increasing energy consumption tax. This will significantly increase interest in energy efficiency and EPC, because energy use will be more and more expensive and consumers are now forced to revise their energy spending. Owing to establishment of sound energy price system, the high energy costs ensure the profitability of investing in energy saving for both the customer and the ESCO. It is suggested to protect environment through energy efficiency projects.

3) The third measure is the crucial government support in the aspects of EPC market, industry policies, related legislations, special fiscal funds and favorable taxes for ESCOs

There is a large energy efficiency market potential for ESCOs in China. It is crucial for Chinese government to take the lead in creating relevant energy efficiency and ESCO promotion policies, including, but not limited to, establishing financial and public procurement policies, opening up governmental facilities or buildings for ESCO projects, setting up efficiency standards and putting up necessary regulatory measures and legislations (such as Energy Performance of Buildings Directive, Energy Services Directive) in place, or reviewing regulations and removing institutional impediments to stimulate further development of the ESCO industry.

It is suggested that the state and all provinces should arrange related special fiscal funds for energy conversation to support cost-effective energy efficiency projects and the development of ESCOs, and bring the implementation performance of energy conversation into government evaluation system. Meanwhile, the Chinese government should bring encouragement into effect for ESCOs implementing highly effective energy conversation projects, and make great efforts to propagandize their outstanding achievements. It is advisable for the government that the concept of green GDP should be actually embodied in the course of policies making and implementation.

Furthermore, reforms are needed in the public finance department and the evaluation of business leaders of the state-owned large-scale enterprises. One recommendation is to enable the finance department of governments at different levels to allow investment today which brings in a reasonable amount of cost savings in the future through the implementation of energy efficiency projects by ESCOs. Evaluation of the business leaders' performance from the state-owned industries should take into account their energy and environmental achievements.

It is recommended that Chinese government may arrange favorable taxes for ESCOs. According to the attributes of the ESCOs services, the tax for their services should belong to sales tax of 5%, not value added tax of 17%. Because of the financial pressure the ESCOs, it is necessary for government to make related policies to permit the ESCOs to pay off the tax in terms of actual return on investment in different times, years or when the contracts expired.

4) The fourth measure to develop financial market and financing sources for the development of the ESCO industry

It is suggested that the government establish energy efficiency guarantee funds for helping ESCOs to loan from banks. The funds can be supported by governments, multilateral agencies and donors in one area. The funds can

develop requisite expertise to appraise the projects and finance the project or enhance the credit through co-financing.

To develop a special energy efficiency financing window in the appropriate financial institutions and design related financial products for energy efficiency projects is recommended to improve financing environment for ESCOs.

ESCOs need working capital for marketing and project preparation and development. Sources of debt and equity financing need to be located. Several possible financing sources should be investigated: commercial banks and lending institutions; venture capital firms; equity funds; strategic partnerships (e.g., utilities and engineering firms); leasing companies; and equipment manufacturers. A revolving fund to finance energy-efficiency measures could also be set up.

It is reported recently that Growth Enterprise Market (GEM) for small and medium scale enterprises (SMEs) will be launched in Shenzhen Stock Exchange in the near future, and this is a new resource for SMEs to finance through capital market. The small and medium scale ESCOs with appropriate size and prerequisites should actively take advantage of this financing resource, strive for coming into the market to finance and obtain the required funds for enterprises development, and better as well as rapidly boost further development of Chinese ESCOs industry.

5) The fifth measure is to create an ESCO accreditation system to define the minimum set of qualifications for ESCOs, together with a system to assure the quality and reliability of services

Accreditation of ESCOs has been referred to as one of the most effective tools to increase trust in the quality of ESCO work, however not widely used in China.

Since a number of companies are eager to call themselves ESCOs, without having proper qualifications, an important action is to ensure that ESCOs provide a qualified and reliable service. Energy saving measures implemented by ESCOs must be certified and verified.

It is proposed that qualifications of enterprises applying for entering the ESCOs industry should be inspected strictly in the respects of technology, financing capability, size, and energy efficiency projects implementing capability etc.; the credit archives of operating ESCOs should be established, and the implementing conditions and performances, capability of making profits and paying off loans of the energy efficiency projects run by these ESCOs should be tracked and investigated timely. Companies' certificates should be revoked if the performances of energy efficiency projects implemented by these companies are too bad, technologies used by these companies are out of date, capabilities of making profits are not good, and the levels of paying off loans on schedule are low.

Furthermore, the ESCOs should build up their capabilities in all aspects besides the capabilities mentioned above (such as capabilities of marketing, risk management, projects implementation, and brand creating etc.), which ensures that ESCOs provide a qualified and reliable service，create a good image itself in the industries.

6) The sixth measure is to build standardizations for EPC contracts, services, and especially measurement and verification (M&V) procedures, and improve the mechanism of benefits distribution

It is urgently required to establish a set of standard contracts, measurement and verification (M&V) procedures and rational benefits distribution system for the expansion of EPC mechanism thoroughly in China.

The development of standard contract terms can help both end users and the financial community better understand performance contracting. The development of standard contracts has been an elusive task because various companies consider their contract approaches unique and proprietary. Rather than developing a single standard energy services agreement, we can now focus on standard language for a set of key contract provisions, such as insurance, equipment ownership and purchase options, which will allow standard contract forms to be built up gradually.

Performance-based projects are subject to M&V protocols, and standardization of M&V procedures is an important activity. The International Performance Measurement and Verification Protocol (IPMVP) is a good reference model for China and ESCOs to initially examine. This will be very useful in solving disputes among parties.

7) The seventh measure is to build trust business environment, and create a credit worthiness system in China

The achievement of this measure relies on the efforts of the ESCOs, clients of EPC, national and regional energy efficiency agencies, associations of ESCOs, equipment manufacturers and suppliers, financial institutions, community agencies, utilities, and related stakeholders of the ESCOs industry.

At present, it is very important for an ESCO to apply a tailored project strategy to manage risks related to clients' credit. Example measures include a guarantee contract, which enables the ESCO to claim part of the clients' equity

when the client ends up breaking the contract. The involvement of a third party financing guarantee institution can be another solution because such an organization often has its own resources and connections to force the clients to comply with the ESCO contracts. Finally, as the government has a strong influence on industries, it would be useful to introduce a government mechanism to help enforce the contracts, e.g. establishing a governmental body where all ESCO contracts can get registered and monitored.

8) The eighth measure is to enhance service ability of EMCA, and train more and more professionals for ESCOs industry in China

In order to promote the development of the ESCOs industry in China, it is necessary for the Chinese EMC Association (EMCA) to enhance its service abilities, introduce innovations for service approaches, expand service fields, create development environment, and help the ESCOs remove various obstacles in the developing course.

It is important for EMCA and related departments of Chinese government to draw and implement EPC training programs for operation personnel of energy efficiency projects, which foster the professional capabilities and qualifications of these operation personnel, especially the energy managers of companies, and make them aware of ESCO activities, ESCO-type projects, and measurement and verification methods and protocols for measuring energy savings.

5. Conclusions

It is necessary for China to pay serious attention to energy conservation and emission reducing. There is a large energy efficiency market potential for ESCOs in China. The market has seen a rapid ESCO growth over the past few years. Although EPC is a relatively new concept for China, in order to meet the large market demand, the expansion on the ESCO industry needs to continue. However, Chinese ESCOs are facing several barriers that include market, finance, institutional, technology barriers, etc. These barriers must be addressed before the ESCOs industry can flourish. Thus, in this paper, a series of corresponding removal measures have been put forward for promoting the ESCOs to improve energy efficiency by energy performance contracting (EPC) and to stimulate further development of the ESCOs industry in China, in favor of Chinese economy kept going sustainably and protecting the global environment.

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